

# **Dashboard visualisation of lifelog data for summarisation and pattern recognition to promote behavioural change**

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## **Abstract**

Lifelogging is a form of pervasive computing, which is capable of recording a catalogue of the totality of an individual's experiences. Lifelogging data can take many forms from daily step counts, sleep monitoring and heart rate data to location based information to video/image diaries from cameras embedded into glasses or clothing or worn. From the perspective of behavioural change, lifelog data is an invaluable resource that can contain many potential insights into a person's patterns and experiences. One major issue with Lifelogging is the sheer volume of user generated data and analysing this wealth of data in a coherent and efficient manner can become increasingly difficult as the datasets become larger and more varied. Through utilising data visualisation techniques in a dashboard interface, or similar, one can make high-level analyses and summarisations of this data much more achievable. This visually intuitive approach to disseminating rich datasets alongside automated and algorithmic machine-learning techniques can lead to valuable user insights and the potential to significantly promote behavioural change.

## **Introduction**

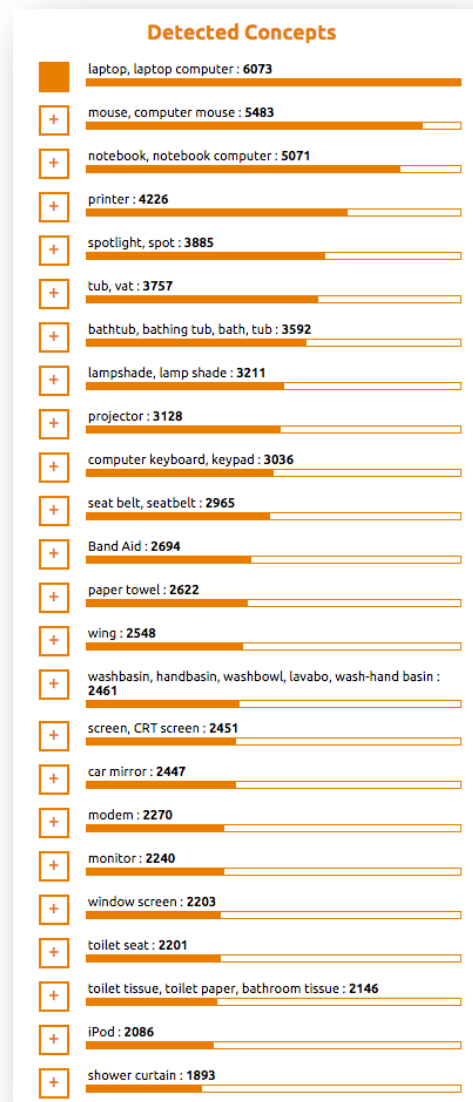
Lifelogging is “a form of pervasive computing, which generates a unified digital record of the totality of an individual's experiences, captured multi-modally through digital sensors and stored permanently as a personal multimedia archive” [1]. The recording of this data has become an increasingly popular phenomenon in recent years due to the advent of personal sensors (e.g. accelerometers, heart rate monitors, global positioning systems) often conveniently embedded in a user's phone or wristband. A single lifelogger can accumulate thousands of images per day and when paired with their myriad other sensor data, the dataset, although potentially very valuable, can quickly become too large to conveniently manage. It is evident that one of the biggest challenges encountered when attempting to analyse this data is the sheer scope of it's size and variance.

Recent techniques to automatically extract actionable information from such image and sensor streams utilise machine learning algorithms and image recognition software, to scan an image and extract potentially relevant terms from a lexicon and assign them confidence values. These terms are referred to as ‘lifelog concepts’. These concepts, along with the images and other sensor data, can form a faceted classification system that is ideally suited to data filtering and search. However, while this process is effective in further disseminating the richness of the data, the method is automated and therefore is always subject to varying degrees of accuracy.

Effective visualisation of data can alleviate many of the complications encountered when working with datasets of this nature. In this work, we present a dashboard interface designed to expose visually intuitive methods of exploring lifelog data. The data consists of physical activities, semantic locations and wearable camera images (about 1,500 per day). The interface itself relies on the automatically generated ‘lifelog concepts’ to both summarise and contextualise the data at any given time. Combined with the additional time and location metrics, we can isolate specific patterns and recurrences which can be further explored via additional visualisation techniques. The insights garnered via this method of analysis can provide knowledge to the individual, which can support effective behavioural change under a range of criteria.

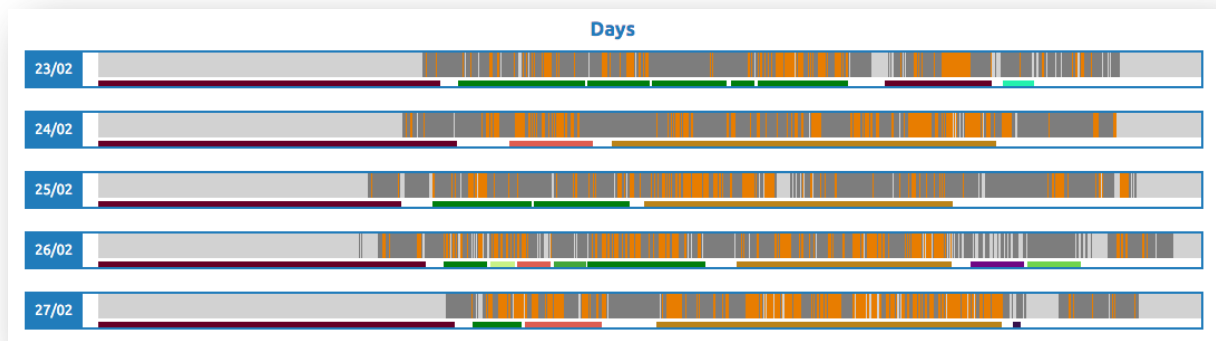
## **System Description**

The interface to visualise lifelog data is divided into three distinct sections. Each of the sections from left to right focuses on a more granular aspect of the lifelog data. The first and leftmost section of the dashboard summarises all of the algorithmically detected ‘lifelog concepts’ that are related to the data and ranks them in an ordered list from most common to least common (see fig. 1). The numbers next to each concept correspond to the amount of images where the term was detected. In this dataset each minute can only contain one image and each image contains up to fifty unique concepts. Each concept in this list can be toggled into an active state which will then highlight corresponding visualisations in the dashboard.



**Figure 10. The Concept List**

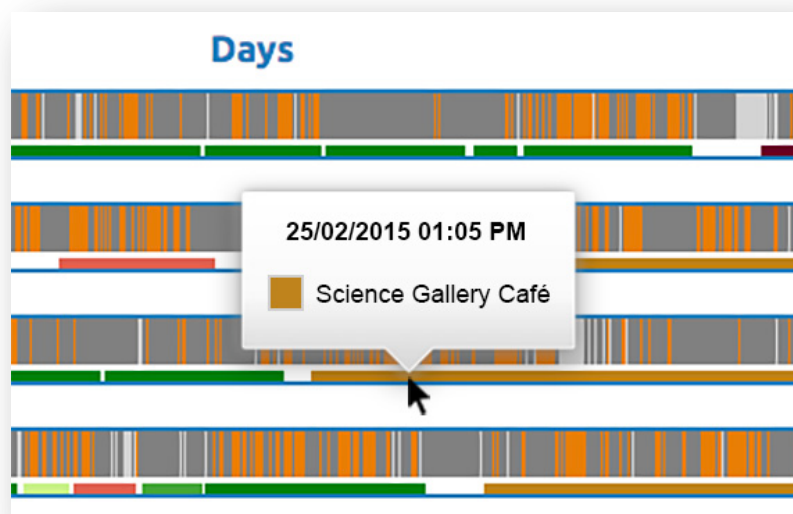
The second section, which is positioned in the centre of the dashboard, displays a high-level overview of each day of lifelog data. A day contains 1,440 individual segments representing each minute of that day (see fig. 2), from 00:00 to 23:59.



**Figure 11. Every Day in 1,440 Segments.**

In their default state each minute is represented by a single vertical line of grey. However, if an image was captured during that minute, it is conveyed to the viewer by a darker shade of grey. The minutes highlighted in orange correspond to the currently active concepts toggled by the user in the previous section. Selecting any concept from the ranked list immediately updates this section to indicate which minutes contain all currently toggled concepts.

Directly beneath each day is related visualisation element that indicates the detected location of the lifelog data at any given time. If the user hovers their cursor over a selected minute of interest, a tooltip is displayed conveying that current time and location (see fig. 3).



**Figure 12. Illustrating the use of Additional Sensor Data**

The third and rightmost section of the dashboard is interacted with by clicking on an individual minute the user wants to further analyse. Upon selection, the third (rightmost) section updates with any known metadata specific to that minute (see fig. 4).

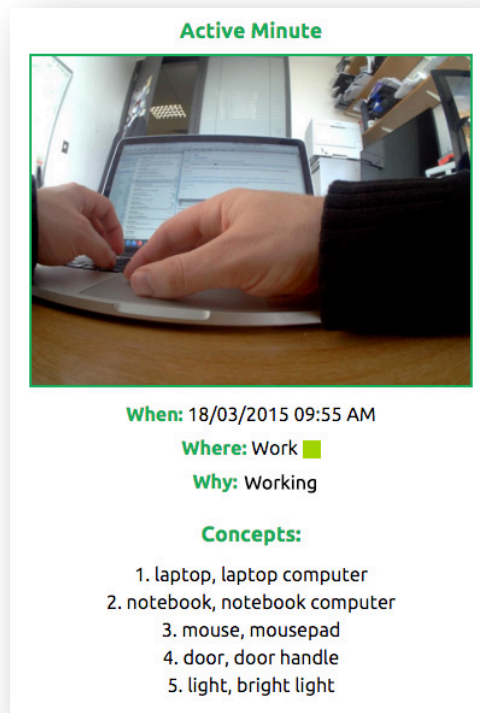


Figure 13. Metadata View of any Minute

If the minute contains an image, it is displayed to the user here at a slightly reduced resolution. This in turn can be clicked on if the full resolution needs to be examined by the user. Beneath the image is a list of all available metadata associated with the minute. In this particular dataset a minute can contain a time, location, an activity and the top five most confident lifelog concepts that were detected in the image.



Figure 14. The Entire Interface View

## Conclusions & Future Work

In this work we present an interface for visualising multi-sensor lifelog data. This interface is developed to allow the individual to browse and extract knowledge from a large archive of lifelog data. Such archives could run for years or decades. This dashboard interface is built on top of a scalable framework that we hope to expand upon in future work. This first iteration of the design addresses specific lifelog datasets but it is highly adaptable. Different quantities and different varieties of data will require different and more innovative techniques for visualisation. For example, there is ongoing research into enhancing and improving the accuracy of the automatically detected lifelog concepts. Additionally, targeting specific behavioural change use cases via new dashboard features is also intended. These features could focus on aspects such as diet monitoring, frequency of exercise and exposure to other characteristics of healthy living. This interface and research will be demonstrated at the 12<sup>th</sup> NTCIR conference in Tokyo this June as part of the Lifelog Insight Task (LIT) to explore knowledge mining and visualisation of lifelogs.

## Acknowledgements

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## References

1. Dodge, M. and Kitchin, R. (2007). “Outlines of a world coming into existence”: Pervasive computing and the ethics of forgetting. *Environment and Planning*, 34(3):431–445.